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(57) Abstract

Prolonged skin contact with a urine or feces soaked diaper can lead to diaper rash unless preventive measures are used. An ion exchange material capable of exchanging ammonium ions from urine is incorporated in a diaper. The diaper may also include material which will remove bacterial and toxic proteins from body wastes. Many natural or synthetic zeolites, for example, mordenite, clinoptilolite, faujasite, zeolite X, zeolite Y, zeolite A, chabazite, or phillipsite are suitable for ion exchange. Such materials will also absorb water as will materials such as kaolin clay, which may be added for removal of bacterial and toxi proteins. Silica gel, bentonite clay or other absorbents may be added, primarily for its high water adsorption.

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DIAPER

BACKGROUND OF THE INVENTION

Conventional, commercially available diapers of the washable type are simply cotton fabric which, except for the inherent water adsorption of the cotton have no special characteristics to absorb, remove, or otherwise treat or condition the urine and feces contained therein during use.

Commercially available disposable diapers have a layer next to the skin which is relatively non-water absorbing but is porous to water, and an inner water absorbent cellulosic fibrous web or fillings, with an outer more-or-less water-impervious layer.

Several patents have been issued which relate to attempts to alleviate the irritation caused by the excreta on the wearers' skin. In particular U.S. Patent 2,643,969 teaches the use of complex organic bacteriostats or bacteriocides to stop or control the action of bacteria which generate ammonia from the nitrogenous waste material, and describes prior use of bichloride of mercury and boric acid as rinses to provide the diaper material with antiseptic properties. U.S. Patent 3,922,723 describes a chemical treatment for cotton-wearing apparel to give it anion exchange properties for control of body odor. There is also reference in the patent to chemically attracting anion exchange resins to fabrics, and (in column 10) it is suggested that cation exchange cottons can be produced by chemical treatment, and that such treatment may be employed in the garments described in the patent. At column 8 of the patent there is a reference to use of the invention in many kinds of garment, including the diaper. U.S. Patent 2,690,415, describes the use of carbon black and silica gel, adhesively secured to the yarns of a fabric for producing an odor eliminating blanket, bandage, or catamenial pad.

U.S. Patent 3,935,363 teaches bentonite as a liquid absorbent in diapers.

The patent and other literature teaches that ammonia present in the waste in a diaper is a cause of diaper rash, and that such disease of the skin in infants can be a serious medical matter which can in extreme cases result in death. U.S. Patent 3,567,820, teaches incorporating organic cation exchange resins in an ointment for application to skin which is afflicted with ammonia dermatitis, or diaper rash. Such resin is present to remove ammonium ions present, or produced by bacterial action in, the diaper contents.

SUMMARY OF THE INVENTION

In the present invention, ammonia (and other toxic or potentially toxic nitrogenous irritants) are removed from the waste matter in the diaper by the incorporation into the diaper of an inorganic aluminosilicate zeolite ammonium ion exchange material. Materials useful in the present invention have a high and a selective capacity for ammonium ion exchange, and have additional sorptive capacity for polar molecules in the intracrystalline pores of the zeolite. Such inorganic aluminosilicate zeolites may be natural or synthetic. Synthetic examples are zeolite F, zeolite W, zeolite A, synthetic faujasites (zeolites X and Y), synthetic mordenite, synthetic clinoptilolite, synthetic gismondine-types, and synthetic phillipsite-types. Examples of the natural zeolites useful in the invention are erionite, ferrierite, chabazite, phillipsite, mordenite, and clinoptilolite. Where it is particularly desirable, a portion of the zeolite may be converted partially or completely to another alkaline earth or alkali ion exchange form such as Na.

Additional water removal can be achieved by incorporating conventional sorbents such as silica gel in the diaper. Additional capacity for removal of ammonia or other toxic substance in the waste can be achieved by incorporation of activated carbon, amorphous permutite type aluminosilicates, crystalline aluminosilicates, or clay

minerals such as kaolinite, bentonite, sepiolite, and attapulgite.

The invention can be applied to conventional cloth diapers and is especially adaptable to disposable, one use diapers.

For conventional cloth diapers, a soft, flexible, water-permeable layer retentively incorporating the ammonium exchange material and any other material such as clay or clay minerals and buffers, is applied to the cloth diapers, or such layer could be applied to the outside or the inside of the diaper in any convenient manner, by pinning or taping, or loosely inserting. A sprinkling of powder of the appropriate zeolite - clay combination can be applied to the surface of the inner layer of the diaper.

In case of disposable diapers, the ammonium exchange material is incorporated in the cellulosic fibrous layer between the porous, permeable sheet adapted to be worn next to the skin of the user, and the normally water-impermeable outer layer of the diaper. If desired, the outer layer need not be impermeable to water, its function being primarily to contain the zeolite and any other sorbent or active materials in the diaper.

The form of the zeolite and of the silica gel, amorphous or activiated carbon and clay minerals will normally be powder or finely divided particulate. Such materials can be effectively retained among the fibers in the interlayer of the diaper. If desired, the zeolite and other particulate materials may be retained in relatively small pouches formed between the inner and outer layers of the diaper, whereby a quilted effect is achieved, as by employing heat bonding of the boundaries of the pouches when at least one of the layers is thermoplastic, or by employing conventional adhesives or by mechanical stitching.

In cases where sodium exchanged zeolites are used to take advantage of the enhanced selectivity for ammonium ion exchange of certain such zeolites for example, mordenite and clinoptilolite. It is desirable to control the pH by the use of buffers. For example, an addition of powdered

disodium hydrogen phosphate in such proportion to yield approximately 2.5×10^{-2} molar concentration in a wet diaper which will buffer a pH range near 7. Other examples of suitable buffers include the combination of potassium dihydrogen phosphate and disodium hydrogen phosphate powders to yield equimolar concentrations of 3×10^{-2} molar in the urine of the wet diaper. Others buffers, for example, boric acid buffers, which will contribute to the control of the growth of bacteria, mold and yeast, can be employed to yield the desired pH. Other buffers yielding a pH range in the urine of the wet diaper of 6 to 8 may also be used.

DESCRIPTION OF THE SPECIFIC EMBODIMENT OF INVENTION

For each square foot (929 square centimeters) of operational diaper area, to significantly reduce irritation from urine and feces (primarily caused by nitrogenous compounds) an effective formulation is: 60 grams of naturally occuring clinoptilolite, in the natural ion exchange form, or preferably, at least, partially or completely sodium exchanged; 35 grams of silica or silica-alumina gel; and 10 grams of kaolinite, 15 grams bentonite, and 3 grams activated carbon. The ingredients are evenly dispersed within the fibrous interlayer of a conventional disposable diaper. Most preferably it is desirable to add a buffer to the above ingredients such as to produce a pH in the wet diaper of approximately 7. A suitable average amount for the 1 square foot of operational diaper area is 0.36 grams Na_2HPO_4 and 0.30 grams KH_2PO_4.

WHAT IS CLAIMED IS:

1. A diaper having a fabric sheet on one side thereof to be worn next to the skin of the user, a fabric layer on the opposite side of said fabric sheet incorporating an effective amount of inorganic zeolite cation exchange material capable of preferentially incorporating ammonium ions whereby the ammonium content of excreta in contact with said diaper in use is reduced.

2. A diaper as in claim 1 in which the zeolite is selected from the group consisting of synthetic zeolites such as zeolite F, zeolite W, zeolite A, synthetic gismondine-types, and/or synthetic or natural mordenite, chabazite, phillipsite, and clinoptilolie, and mixtures thereof.

3. A diaper as in claim 1 wherein a clay or clay mineral is incorporated therein.

4. A diaper as in claim 1 having silica gel incorporated therein.

5. A diaper as in claim 4 wherein the clay mineral is kaolinite.

6. A diaper as in claim 4 wherein the clay mineral is bentonite.

7. A diaper as in claim 1 in which the zeolite is sodium mordenite.

8. A diaper as in claim 1 in which the zeolite is sodium clinoptilolite.

9. A diaper as in claim 1 in which the zeolite is zeolite F in the potassium form.

10. A diaper as in claim 1 wherein the cation exchange material is a permutite type crystallographically amorphous aluminosilicate.

11. A diaper as in claim 1 including a buffer.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US80/01662

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[3] A41B 13/02
U.S. Cl. 128/284

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	128/284,287,290R,290W,290P,296; 423/118; 252/179; 428/240-242,281,453,454

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category [15]	Citation of Document, [16] with Indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	U.S.,A, 2,023,253, Published 03 December 1935 STEIN	1-3,8-11
A	U.S.,A, 2,750,944, Published 19 June 1956 TOLLSTRUP	4,6,7
A	U.S.,A, 3,172,817, Published 09 March 1965 LEUPOLD ET AL	1-3,8-11
A	U.S.,A, 3,381,688, Published 07 May 1968 SATAS	5
A	U.S.,A, 3,528,421, Published 15 September 1970 VAILLANCOURT ET AL	1-11
A	U.S.,A, 3,832,327, Published 27 August 1974 HACKBARTH ET AL	1-3,8-12

* Special categories of cited documents: [16]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
28 January 1981	17 MAR 1981
International Searching Authority [1]	Signature of Authorized Officer [20]
ISA/US.	C.F. Rosenbaum

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